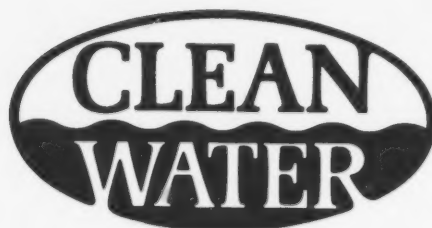


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Federal Water Pollution Control Administration
Division of Water Quality Research
Analytical Quality Control Laboratory
Cincinnati, Ohio

W71-04192



EVALUATION REPORT 1: AUTOMATIC BEAKER SAMPLE CHANGER

JANUARY, 1970



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L. B. Lobring, and R. L. Booth

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EVALUATION REPORT 1: AUTOMATIC BEAKER SAMPLE CHANGER

L.B. Lobring and R.L. Booth

SUMMARY

A prototype sample changer, called the Beaker Butler, that presents liquid samples to a variety of electrodes was evaluated. Use of this automated step gave results comparable to manual methods with a significant reduction in cost and man hours.

INTRODUCTION

Presenting a sample to an electrode has always been a problem to the analyst performing a large number of determinations. With the introduction of ion-selective electrodes, a solution to this problem has become more urgent. Accordingly, a prototype sample changer, called the "Beaker Butler", manufactured by Vision Laboratories, Inc., Oriskany, New York, was purchased to determine its usefulness. The Butler presents a standard 100-ml glass beaker to electrodes suspended above in a prealigned position. Up to 50 beakers are held in a circular, rotating tray that positions each beaker over a timer activated lifting device. The lifter elevates the beaker to the stationary electrodes, with contact time variable up to 4 min. A variable speed mechanical stirring device suspended with the electrodes insures good mixing of the sample while in contact with the electrodes.

Electrodes used for the evaluation were Beckman No. 4990-83 pH Electrode and Orion No. 94-09 Fluoride Specific Ion Electrode with Orion's No. 90-01 Single Junction Reference Electrode. Instrumentation included Orion's Model 801 digital pH/mv meter coupled to a Beckman Model 93501 linear potentiometric recorder.

Photographs of the Beaker Butler and a close-up of the sample presentation are shown in Figures 1 and 2.

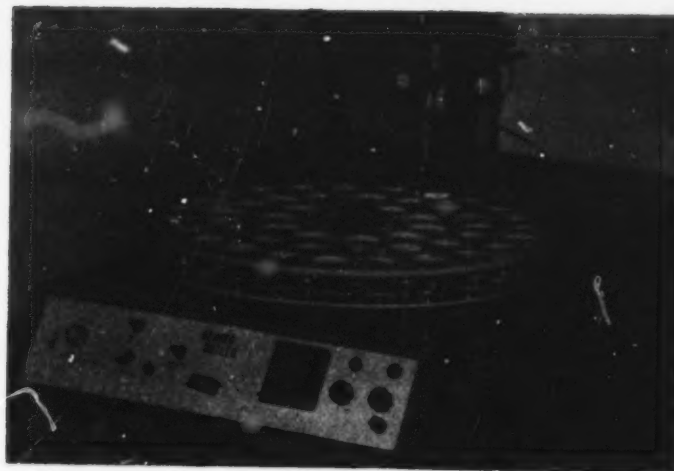


Figure 1. The Beaker Butler.



Figure 2. Sample Presentation by the Beaker Butler.

SAMPLES

Samples used for this evaluation were Ohio Basin Region surveillance surface water samples for the month of September, 1969. Included were samples from the Licking, Kentucky, Great Miami, Whitewater, and Ohio Rivers, thus providing a variety of sample types for evaluation.

PROCEDURE

The pH system was calibrated against standard buffer solutions of pH 4.0, 7.0 and 10.0. The recorder was calibrated pH 5.0-10.0 full scale. Sample contact time with the electrodes was set at one minute with constant stirring. The rate of stirring was adequate to insure thorough mixing of sample, but not rapid enough to cause air entrapment. To control sample contamination by solution carryover, a small amount of silicone oil was applied to the electrode bodies and buffered standards were followed by a distilled water wash. Reliability of results was checked by comparing them to results obtained by the manual glass electrode method.⁽¹⁾

The fluoride system was standardized with known solutions of 0.1, 0.2, 0.4, 0.8, and 1.0 mg/l fluoride registering full scale on the recorder. Samples and standards were diluted 1:1 with a buffer solution as described in the instruction manual supplied with the fluoride electrode. Sample contact time with the electrodes was set at 3.5 minutes. Both reference and fluoride electrodes were coated with silicone. Reliability of results was checked by comparing them to results obtained by the automated Technicon complexone method.⁽¹⁾

RESULTS

Results for the pH and fluoride methods are given in Table 1. As the average values show, the results obtained by use of the automated Beaker

Butler compare most favorably with the FWPCA Methods. Experience showed that no wash was needed between samples, but that contamination could occur to samples immediately after a buffered standard of significantly different pH. In such situations, a wash is necessary.

TABLE 1
COMPARISON OF "BEAKER BUTLER"
USAGE WITH FWPCA METHODS

<u>Sample</u> (River, Location)	<u>pH, Units</u>		<u>Fluoride, mg/l</u>	
	<u>Beaker Butler</u>	<u>Manual</u>	<u>Beaker Butler</u>	<u>Automated Complexone</u>
Ohio at Ironton	7.0	6.9	0.38	0.39
Ohio at Greenup Dam	7.0	6.9	0.35	0.37
Ohio at Portsmouth	7.0	6.9	0.32	0.33
Ohio at Maysville	7.0	7.0	0.25	0.27
Ohio at Meldahl Dam	7.1	7.0	0.26	0.28
Little Miami, Cincinnati	8.1	8.0	0.21	0.20
Ohio at Cincinnati	7.2	7.2	0.26	0.30
Licking at 12th Street			0.24	0.26
Ohio at Miami Fort	7.0	6.9	0.30	0.30
Ohio at Markland Dam			0.32	0.30
Kentucky at Dam 1			0.19	0.16
Ohio at Madison			0.30	0.30
Great Miami at Eldean	7.8	7.7	0.52	0.50
Great Miami at Sellars Road	8.1	8.1	0.50	0.45
Great Miami at Liberty-Fairfield	7.4	7.4	0.40	0.39
Great Miami at Amer. Nat. Bridge	7.5	7.5	0.43	0.42
Whitewater at Suspension	8.3	8.2	0.20	0.18
Great Miami at Lawrenceburg	7.6	7.6	0.39	0.42
Ohio at Anderson Ferry			0.30	0.30
AVERAGE VALUE	7.4	7.4	0.32	0.32

A time cost comparison of the Beaker Butler vs the manual methods and the automated Technicon method are summarized in Table 2. Costs are based on a technician earning \$6,000/year base pay, plus \$6,000/year support costs, or \$1,000 per month. On the basis of 168 working hours per month, the hourly rate would be \$6.00.

Results calculated for 50 pH samples showed a savings of \$13.00 and 2 hrs. 15 min. operator time when using the Beaker Butler. Time and cost figures on the Butler and Technicon fluoride method are comparable for 50 samples; however, initial investment for equipment is considerably higher for the Technicon method. The Beaker Butler is also far more portable and adaptable to other instruments than the Technicon unit, and there is not a time lag in obtaining results. Comparing the two automated methods to the manual distillation method ⁽¹⁾ for 50 samples, and assuming 14 distillations per day, a savings of \$222 and 37 hrs. 30 min. operator time were realized.

TABLE 2

TIME/COST COMPARISON OF PROCEDURES

Procedure	Time for 50 Samples in hrs.	\$ Cost for 50 Samples
pH		
Beaker Butler	0.75	5
Manual	3.0	18
Savings	2.25	13
Fluoride		
Beaker Butler	2.5	18
Technicon	2.5	18
Manual	40.0	240
Savings	37.5	222

CONCLUSIONS

1. In measuring pH and fluoride concentrations in surface waters, the Beaker Butler, in conjunction with probe methods, yields data comparable to that obtained by manual and Technicon procedures employing FWPCA Methods.
2. Time/cost studies show that the use of the Beaker Butler results in significant cost savings and, more importantly, frees the analyst for performing other duties.

REFERENCE

1. FWPCA Methods, Nov. 1969.